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HANDBOOK

Operating and Service Instructions
Parts Lists

Comparator and Deadweight
Pressure Determination System

Mansfield & Green Type "T"

For use with distilled water or other fluids compatable with 300 series stainless steel.

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MANSFIELD & GREEN DIVISION
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Form No. 68-23 (Rev. 2)
October 1988

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Dead Weight Tester Accuracy

Guaranteed accuracy of any hydraulic dead weight pressure tester or dead weight gage is ±0.1% of output pressure, however, limitations due to decreasing sensitivity resulting primarily from friction make it difficult to reproduce accuracy at the low end of the tester range.

Generally, dead weight testers are used only in the upper 90% of the range when best accuracy is required.

Calibration to + .025 is available with data furnished certified traceable to N.B.S. Calibration data is determined by cross floating against a primary standard certified by N.B.S. A common pressure is applied to both units and observed deviations of the tester being calibrated are translated into percent error of output pressure.

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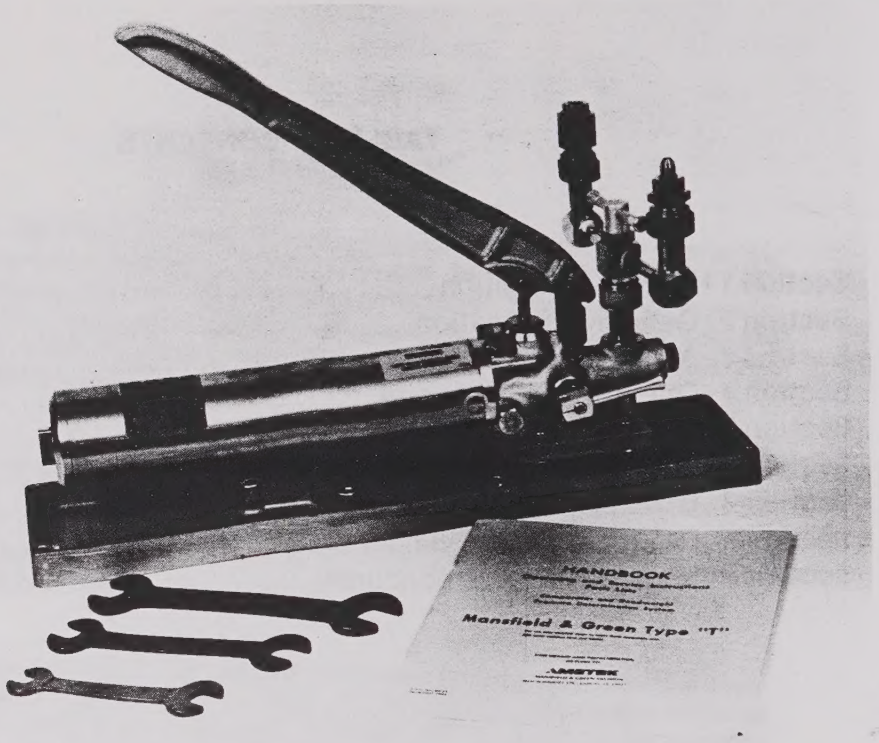


Fig. 1. Assembled View Model T1 Pressure Tester

Fig. 2. Assembled View Models T3 and T3A Pressure Tester

Fig. 3. Assembled View Model T-50 Pressure Tester

Fig. 4. Assembled View Model T-100 Pressure Tester

SECTION 1: MODEL DESCRIPTION

1.0 Pressure Pumps -
These units are pressure sources designed to provide pressure to test devices external to the pump. The pump is connected to the device being tested by a high pressure tube provided by the user.

CAUTION

The pressure rating of the tubing and fittings used to connect the pump to the test device must exceed the pressure capability of the pump (15,000 psi).
Never add fluid to the reservoir during a hydraulic test. The volume of oil pumped must never exceed the reservoir volume, or reservoir will overfill when the relief valve is opened.

1.1 Model T -
Hand Pump mounted on drip pan with ¼" pipe thread union body.

1.2 Model T1 -
Hand Pump mounted on drip pan with manifold pipe assembly: (one each) ¼" & ½" pipe threa union bodies; and (one each) ⅝" x ¾", 1", & 1⅛" wrenches. See figure 1.

2.0 Comparator Testers and Deadweight Testers
These units are self-contained pressure sources designed to test instruments that are co nected to the manifold. They can be used for the calibration of pressure gauges or for settin hydraulic relief valves and pressure switches. These units produce known pressures to te components or systems that are connected to the instrument and are independent of othe pressure sources.

2.1 Model T3 -
Complete kit for comparator testing with metal carrying case; hand pump mounted on drip pa manifold pipe assembly; pointer puller and hand set; (one each) ¼" and ½" pipe thread, and 7/16" 20 UNF union bodies; 7/16" - 20 UNF nipple; (one each) ⅝" x ¾", 1" 1⅛" wrenches; (one each) 5/32" ¼" hex keys; and (one each) 4½" test gauges with monel element and socket, and with unio body mounted on socket, in ranges of 0-160, 0-600, 0-5000, and 0-10,000 psig. See figure 2.

2.2 Model T3A -
Same as Model T-3 except with test gauge ranges of 0-30, 0-600, 0-3000, and 0-5000 psig.

2.3 Models T-5 Thru T-155 -
Complete kit for deadweight testing in various ranges from 10 to 500 thru 100 to 15,000 psig. I cludes metal carrying case; hand pump mounted on drop pan; manifold pipe assembly; point puller and hand set; (one each) ¼" x ½" pipe thread union body with 7/16" - 20 UNF nipple; (on each) ⅝" x ¾"; 1" & 1⅛" wrenches; (one each) 5/32", 3/16" & ¼" hex keys; deadweight column wi mounting screws; weight supporting tube; and, from the chart below, the weights and pist and cylinder assembly.

2.4 Type T Deadweight Testers have suspended weights of a hard, non-magnetic die cast alloy. Type TQ Deadweight Testers have suspended weights of forged brass conforming to materi requirements of the National Bureau of Standards, Class Q. Weights are calibrated to Intern tional Standard Gravity 980.665 gals. Standard accuracy 0.1% of indicated pressure traceab to N.B.S., .05 & .03% accuracies available on special order.

2.5 Optional Equipment for Models T-5 thru T-155

A device called an isolating membrane (see Fig 8b), is available which has the following features:

(a). Isolates harmful dirt particles, originating in the system being calibrated and/or the pump, from the piston and cylinder. Also see par. 2.4

(b). Allows the use of M & G instrument oil in contact with the piston and cylinder assembly which will reduce the rate of fluid leakage thru that assembly. This reduces the frequency of the pumping required to maintain the piston in the referenced calibration plane.

DEADWEIGHT TESTERS – PSIG

Model	Model	Range-psig	Increments	Piston Area	Weight Set
T-5	TQ-5	10-500	5 psig	0.1 sq. in.	#1
T-10	TQ-10	10-1000	5 psig	0.1 sq. in.	#2
T-15	TQ-15	10-1500	5 psig	0.1 sq. in.	#3
T-20	TQ-20	20-2000	10 psig	0.05 sq. in.	#2
T-30	TQ-30	20-3000	10 psig	0.05 sq. in.	#3
T-55	TQ-55	50-5000	25 psig	0.02 sq. in.	#2
T-110	TQ-110	100-10,000	50 psig	0.01 sq. in.	#2
T-155	TQ-155	100-15,000	50 psig	0.01 sq. in.	#3
T-50 Dual Range	TQ-50 Dual Range	10-500 100-5000	5 psig 50 psig	0.1 sq. in. 0.01 sq. in.	#1
T-100 Dual Range	TQ-100 Dual Range	10-1000 100-10,000	5 psig 50 psig	0.1 sq. in. 0.01 sq. in	#2
T-150 Dual Range	TQ-150 Dual Range	10-1500 100-15,000	5 psig 50 psig	0.1 sq. in. 0.01 sq. in.	#3

WEIGHT SETS FURNISHED WITH T & TQ TESTERS

Weight Set Number	Weights Furnished Per Nominal Weight				Number of Cases
	0.5 lb. (WG-23)	2.0 lb. (WG-25)	9.5 lb. (WG-26)	10 lb. (WG-27)	
#1	4	4	1	3	1
#2	4	4	1	8	2
#3	4	4	1	13	3

COMPARATOR TESTERS

Model	Test Gauge Ranges
T-3	0-160, 0-600, 0-5000, 0-10,000 psig
T-3A	0-30, 0-600, 0-3000, 0-5000 psig

PUMP

Model	Description
T	Hand Pump on pan
T-1	Hand pump on pan with dual manifold, fittings & tools
T-2	Hand pump on pan with dual manifold, fittings tools & carrying case

DEADWEIGHT TESTERS – METRIC: Kg/Cm^2

Model	Model	Range-Kg/Cm^2	Increments	Piston Area	Weight Set
TD 400 M Dual Range	TDQ 400 M Dual Range	1.0 to 40.0 10.0 to 400.0	0.5 Kg/Cm^2 5.0 Kg/Cm^2	0.1 sq. in. 0.01 sq. in.	#1 M
TD 700 M Dual Range	TDQ 700 M Dual Range	1.0 to 70.0 10.0 to 700.0	0.5 Kg/Cm^2 5.0 Kg/Cm^2	0.1 sq. in 0.01 sq. in	#2 M
TD 1000 M Dual Range	TDQ 1000 M Dual Range	1.0 to 100.0 10.0 to 1000.0	0.5 Kg/Cm^2 5.0 Kg/Cm^2	0.1 sq. in 0.01 sq. in	#3 M

Weight Set No.	Weights Furnished Per Nominal Weight					Number of Cases
	Converter (WG-201)	0.5 Kg.	2.0 Kg.	9.0 Kg.	10.0 Kg.	
#1 M	1	4	4	1	2	1
#2 M	1	4	4	1	5	2
#3 M	1	4	4	1	8	3

Part WG-201 added to part WG-53, with no other weights added, changes output to

1.0 KG/CM^2 with WG-89 Piston Assembly
2.0 KG/CM^2 with WG-90 " "
5.0 KG/CM^2 with WG-91 " "
10.0 KG/CM^2 with WG-92 " "

Weights used and pressures produced are:

PART No.	MASS	PRESSURE PRODUCED IN KG/CM^2 on -			
		WG-89	WG-90	WG-91	WG-92
WG-205	0.323 Kg	0.5	1.0	2.5	5.0
WG-204	1.290 Kg	2.0	4.0	10.0	20.0
WG-203	5.806 Kg	9.0	18.0	45.0	90.0
WG-202	6.451 Kg	10.0	20.0	50.0	100.0

DEADWEIGHT TESTERS – METRIC: KN/M^2, BARS, & KPA

Model	Model	Range - KPA	Increments	Piston Area	Weight Set
TD 40000 N	TDQ 40000 N	100 to 4,000 1000 to 40,000	50 KN/M^2 500 KN/M^2	0.1 sq. in. 0.01 sq. in.	#1 N
TD 70000 N	TDQ 70000 N	100 to 7,000 1000 to 70,000	50 KN/M^2 500 KN/M^2	0.1 sq. in. 0.01 sq. in.	#2 N
TD 100000 N	TDQ 100000 N	100 to 10,000 1000 to 100,000	50 KN/M^2 500 KN/M^2	0.1 sq. in. 0.01 sq. in.	#3 N

Weight Set No.	Weights Furnished Per Nominal Weight					Number of Cases
	Converter (WG-301)	50 KPA	200 KPA	900 KPA	1000 KPA	
#1 N	1	4	4	1	2	1
#2 N	1	4	4	1	5	2
#3 N	1	4	4	1	8	3

Part WG-301 added to part WG-53, with no other weights added changes output to:

100 KPA WITH WG-89 PISTON ASSEMBLY
200 KPA WITH WG-90 PISTON ASSEMBLY
500 KPA WITH WG-91 PISTON ASSEMBLY
1,000 KPA WITH WG-92 PISTON ASSEMBLY

Weights used and pressures produced are:

		Pressure Produced in KPA ON			
Part No.	Mass	WG-89	WG-90	WG-91	WG-92
WG-305	328.94 gm	50	100	250	500
WG-304	1315.76 gm	200	400	1000	2000
WG-303	5920.919 gm	900	1800	4500	9000
WG-302	6578.799 gm	1000	2000	5000	10,000

SECTION 2: - GENERAL INFORMATION

WARNING

DO NOT CONNECT ANY EXTERNAL PRESSURE SOURCE TO THIS INSTRUMENT. THIS UNIT IS DESIGNED TO TEST PRESSURE MEASURING DEVICES CONNECTED TO THE MANIFOLD ONLY. PRESSURE FROM AN EXTERNAL SOURCE CAN RESULT IN EXPLOSION OF THE LIQUID RESERVOIR AND POSSIBLE BODILY INJURY.

2.1 All wetted parts are stainless steel or monel. All pumps are shipped with a 50-50 mixture of distilled water and isopropyl alcohol in the reservoir. The alcohol is added merely to prevent freezing during shipment and the mixture keeps the o-rings moist during storage. This pump can also be used with other fluids compatible with 300 series stainless steel.

CAUTION

2.2 Do not operate hand pump without fluid in the reservoir - piston O-rings require lubrication.
Deadweight Testers should be bolted to bench to prevent tipping.
Do not operate above 15,000 PSIG.
Vent plug **must be open** when operating this instrument.
Vernier Valve will not operate above 3500 PSIG.
Never add fluid to reservoir during a hydraulic test. The volume of fluid pumped must never exceed the reservoir volume, or reservoir will over-fill when relief valve is opened.

2.3 (DEAD WEIGHT COLUMN) PISTON CYLINDER ASSEMBLY - The piston is hardened, plated, ground and lapped. The cylinder is honed and polished.
Total piston travel is 0.5 inch.
Piston driver WG-56 moves vertically inside the cylinder cap WG-52 which acts as a stop. Excess pressure cannot force the piston out of the cylinder.

2.4 NECESSITY FOR CLEANLINESS - Clearances between the piston & cylinder are on the order of a few millionths of an inch. This necessitates extreme cleanliness and care as follows:

a). HANDLING. Handle and install so as not to introduce scratches or nicks. Do not touch the working surfaces (O.D. of piston & I.D. of cylinder) with your hands or with dirty fabrics or fibers.

b). FLUID CONTAMINATION - Since the pump fluid (possibly from the system being calibrated) flows thru the annulus space between the piston and cylinder, any foreign particles in the fluid system which can enter the annulus space can cause severe damage to the piston and cylinder. In severe cases, "binding" or "freezing" can occur.

c). See par. 6.6 for cleaning procedure.

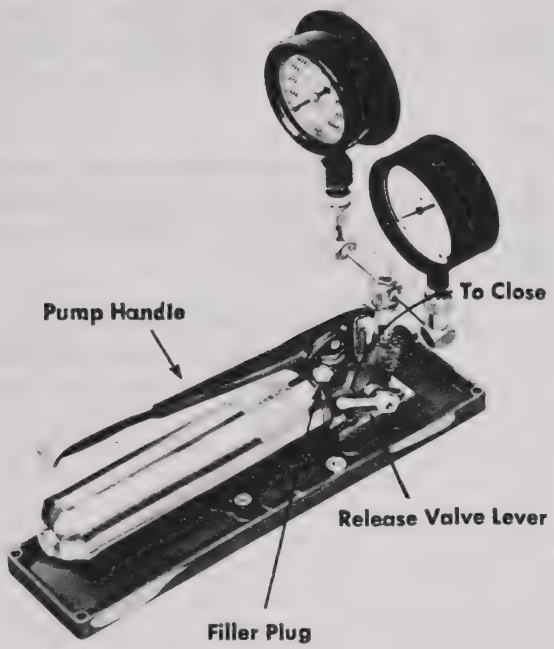
2.5 Keep weights clean and stored in cases when not in use. Do not allow them to be scratched or dropped.

2.6 The weight tube WG-53 has a calibration reference line on it which is an indication of the bottom of the piston. This is for use in calculating the head which exists when calibrating a system which is at a different level than that of the instrument.

2.7 The vent plug may be equipped with a relief valve to avoid pressure built-up in the reservoir. However, the vent plug must be opened during use to allow proper operation of pump.

SECTION 3: - ASSEMBLY & SET-UP INSTRUCTIONS

COMPARATOR TESTING



3.1-1 Attach T-403 manifold assembly to pump body.

3.1-2 Attach test gauge to manifold.

3.1-3 Attach instrument to be calibrated to manifold.

DEADWEIGHT TESTING

3.1-1 The hand pump, as shipped is assembled to the drip pan in position for comparator testing. Remove the 4 pump attaching screws, turn pump 180°, and reassemble pump to drip pan. Do not tighten bolts.

3.2-2 Remove the plug and O-Ring (T-103 & 10-90009) from the front of the plug body.

3.2-3 Remove the nipple and nut (T-126, 10-90009 & T-146) from the manifold assembly. Replace these with the plug and O-Ring removed from the pump body.

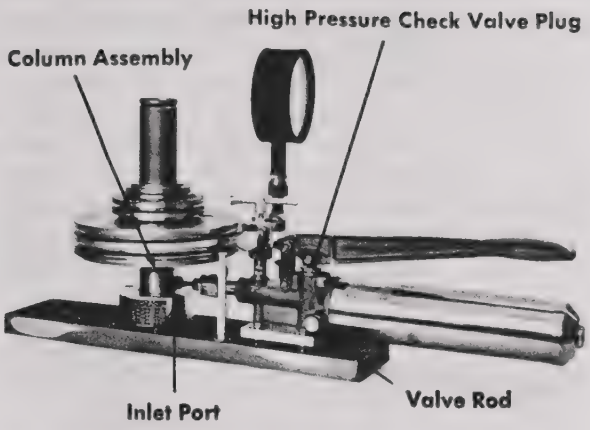


Fig. 6. Dead Weight Testing

3.2-4 Assemble nipple & nut into the end of the pump body.

3.2-5 Connect the column assembly to the nipple and nut, then fasten the column to the drip pan.

3.2-6 Tighten the screws to secure the pump to the drip pan.

NOTE: Clean piston & cylinder per Section 8 before installing.

3.2-7 Dual range models: Select the correct piston and cylinder to suit the required pressure range. Use the table at the end of section 1 or the decal attached to the comumn assembly base as a guide.

3.2-8 Installing or changing piston and cylinder assemblies: Remove the eight (8) socket head cap screws which hold the cylinder cap to the body. Remove the piston and cylinder assembly (figures 8a & 8b). If necessary, use blunt edged screw driver under groove on top of cylinder and pry gently upwards. Refer to figures 8a & 8b for proper assembly of back-up ring & O-Ring or membrane.
Wet the outer surface of the O-ring or membrane before working the assembly into the column body.
After installing the cylinder, replace the

cylinder cap and tighten 4 bolts. This will set the cylinder into place. Remove bolts and cap. Pump fluid to top of cylinder.

3.2-9 Filling procedure for units with optional isolating membrane: a special oil, M & G "AAA" oil, is provided in the plastic bottle. To dispense the oil, the capillary tube must be pushed down into the cylinder bore and gently squeeze the bottle to fill the membrane up to the bottom of the cylinder bore. Using the hand pump, carefully pump fluid into the column so as to compress the membrane and bring its fluid level to the top of the cylinder bore.

3.2-10 Coat the piston with a light film of the M & G oil and carefully work down into cylinder bore while simultaneou releasing pump pressure so that piston will enter the cylinder b without any trapped air.

3.2-11 Replace cylinder cap and fasten loos with four (4) opposing screws. Tigh alternately to 30 in. lb. Repeat this cedure with the four (4) remain screws.

3.2-12 Rotate the piston driver until you fe drop onto the drive pin in the piston c see figure 10. Slide the tube onto tube carrier.

3.2-13 Place a bullseye level on the tube car before using to assure that the colum level. Shim the base if necessary.

SECTION 4: · OPERATING INSTRUCTIONS

WARNING

DO NOT CONNECT ANY EXTERNAL PRESSURE SOURCE TO THIS INSTRUMENT. THIS UNIT IS DESIGNED TO TEST PRESSURE MEASURING DEVICES CONNECTED TO THE MANIFOLD ONLY. PRESSURE FROM AN EXTERNAL SOURCE CAN RESULT IN EXPLOSION OF THE LIQUID RESERVOIR AND POSSIBLE BODILY INJURY.

CAUTION

THE VENT PLUG (1GT-302) MUST BE OPEN WHEN OPERATING THIS INSTRUMENT. SOME MODELS OF THIS TESTER INCLUDE A PRESSURE RELIEF VALVE (13-90025) WITHIN THE VENT PLUG. IF THE RELIEF VALVE IS ACTUATED, THE OPERATOR SHOULD STOP ALL USE OF THIS INSTRUMENT AND REMOVE THE SOURCE OF PRESSURE WITHIN THE RESERVOIR.

4.1 The pressure source for all models is the hand operated, dual volume pump. To develop pressure, the release valve lever must be rotated clockwise until firmly seated. The valve rod controls the output volume (for location, see fig. 6). With the valve rod in the "out" position (away from the pump body), the output volume is at its maximum, although you will only be able to reach about 1000 psi using normal effort on the pump handle. To go beyond 1000 psi, it will be necessary to push the valve rod "in" (toward the body). This reduces the output volume to ease the effort required to operate the pump handle. The valve rod *should only be moved if* the pump handle is stationary or in the suction stroke. The pump has been primed and tested before shipment. If, for any reason it does not function, refer to section 6, Service Instructions.

COMPARATOR TESTING

4.2 Always choose a "test gauge" of (ideally) the same range but never less than that of the instrument system to be calibrated. With the "test gauge" and instrument system to be calibrated connected to the manifold, pump up the system pressure close to the calibration point desired. With the vernier handle, adjust the system pressure until the "test gauge" indicates the desired pressure and then "compare" with the indication given by the instrument system being calibrated. Checks should be made at various increasing and decreasing pressures.

DEAD WEIGHT TESTING

4.3 The mimimum pressure, which can be calibrated, is the pressure developed by the force of the rotating parts which are the piston, piston driver, tube carrier and tube acting on a piston of a certain area. The values, in psi, for the rotation parts, are listed on a decal affixed to the base (item 21, fig. 10) along with the values for the different weights.

The following is an example which shows how to select weights for a certain output: To obtain a 145 psi output using a 1/10 square inch area piston you would add onto the weight carrier tube the following: the grooved 9" dia. weight (95 psi), two 6" dia. weights (20 psi each), plus one 3½" dia weight (5 psi). The sum of the (weights) psi values is 140 and adding the 5 psi value of the "rotating" parts brings the total up to the desired 145 psi.

4.4 Build up system pressure with the hand pump until the weights lift. This can be observed by comparing the vertical position to the bottom weight with the indicator. The ideal "float" position is at one half the total vertical travel of the weight stack. Rotate the weights at about 10 to 30 rpm to reduce friction. Use the vernier piston, in the center of the manifold to make the fine pressure adjustments.

SECTION 5: - TROUBLE SHOOTING

5.1 All pumps are throughly tested at the factory, before shipment. One of the most common difficulties encountered with the pump is the loss of prime, which is evidenced by an inability to build pressure. See figures 5 & 6 for identification of components mentioned below.

For priming purposes, PUMP VIGOROUSLY with full strokes of the hand lever.

Make sure the pump reservoir has sufficient fluid, then pull the valve rod out and pump about ten full strokes with the relief valve open. Close relief valve and continue pumping to be certain the "low pressure" is operating and holding pressure. Open relief valve and pump about ten more strokes.

CAUTION: Remember that the gauges and/or systems on the manifold will be subject to any pressures developed during the priming sequence. Therefore, they should have at least a 5000 psi range or be removed from the manifold and the manifold plugged.

Remove "high pressure" check valve plug and slowly pump two and one-half strokes to position hand lever about half way up 45 degrees. With the plug removed system fluid will flow out of the high pressure check valve, flushing the entrapped air. Examine for air bubbles which may adhere to the threads or parts. Replace the plug and when almost tight use slight pressure on the hand lever to cause leakage at the plug to insure complete purging of valve port. Then secure plug. All of the above with valve rod **out** ("low pressure - large volume").

Operate the pump handle with relief valve closed until sufficient pressure developes to make pumping difficult. Stop pumping, raise the pump handle, push the valve rod **in** and resume pumping. The "high pressure - small volume" mode should then be operating properly.

If the "high pressure-small volume" does not operate or operates only partially, more air is in the "high pressure" check valve and the priming procedure must be repeated.

Generally when once primed the pump will continue to operate without further attention. It is possible that entrained air in the reservoir may collect in the "high pressure" check valve. If that happens the pump will not develop pressure with the valve rod **in**, ("high pressure-low volume"). The above priming procedure will correct the condition.

5.2 In an emergency or when time is not available for the priming operation, the "high-pressure-small volume" can be operated as follows: with the valve rod **out**, operate pump until pumping effort becomes excessive, do not force. For higher pressures raise hand lever (with valve rod **out**) push valve rod **in** for the down stroke of the hand lever and repeat the entire sequence for each stroke of the hand lever.

5.3 FAILURE TO PUMP: If the hand lever is operated and the pump fails to develop pressure, be sure relief valve is closed and that there is sufficient fluid in the reservoir. If necessary, add fluid thru vent plug (fig. 5) and prime per par. 5.1. If failure continues, one or both of the check valves may be leaking. Replace both o-rings to be sure.

5.4 FAILURE TO HOLD PRESSURE: - If the pump operates but the pressure drops, either one or two parts is leaking. As the pressure drops, watch the hand lever, if it raises, the discharge check valve is leaking. Replace o-ring.

If the hand lever does not raise as the pressure drops, then the relief valve is leaking. A foreign particle may be lodged on the seat, but more likely the o-ring has failed and must be replaced.

SECTION 6: · SERVICE INSTRUCTIONS

6.1 CHANGING O-RINGS: Always lubricate the o-rings and all contacting metal parts before attempting assembly. For a lubricant, use the same fluid as will be used in the system.

6.2 OUTLET CHECK VALVE: To re-assemble, thread-in the retaining plug until all parts are solid, then backoff about 3½ turns. This provides sufficient travel for the poppet.

6.3 The valve rod is held in place by items 25, 26 and 27 (fig. 9). Access to these three items is gained by removing the reservoir. Be sure to drain fluid before removing reservoir.

6.4 HAND LEVER & PISTON: These can be removed as an assembly for inspection of the piston o-rings and back-up rings. Merely unscrew cylinder retain plug and pull straight up.

At the end of the pressure stroke, the piston should bottom on the body plate insert before the lever hits the cylinder retaining plug. If it doesn't, or if you would like more finger room between the hand lever and the reservoir, loosen piston pin screw, insert a small rod in the crosshold provided in the piston and backoff the piston (which is threaded into the piston pin) as needed. Be sure to retighten the set screw.

6.5 PUMP CYLINDER: This part must be removed and reassembled from the top, otherwise the o-rings will be cut by the angular, intersecting hold in the lower portion of the body casting bore. To remove the cylinder, detach body plate and push out cylinder from bottom. On re-assembly, moisten the o-rings with system fluid and try to rotate the cylinder, as you insert it, to avoid cutting or pinching the o-rings. A tapered piece of wood is helpful to rotate the cylinder.

6.6 CLEANING DEAD WEIGHT COLUMN, PISTON & CYLINDER: See par. 3.2-8 for instructions on removal. (See page 24 for Cleaning Instructions.)

6.7 REPLACING FLUID IN DEAD WEIGHT UNITS HAVING ISOLATING MEMBRANE: To operate with the required degree of sensitivity, there must be a controlled clearance between cylinder bore and piston. Therefore, there will be some leakage of fluid through this annulus area. The loss of fluid will depend upon length of test period, range of pressure determinations and test conditions. The amount of fluid in the isolating membrane should be checked periodically. To refill, see para. 3.2-9.

SECTION 7

PARTS BREAKDOWN

PUMP PARTS ---------- FIG. 9 (Pg. 19)

ITEM NUMBER	PART NUMBER	DESCRIPTION	UNITS PER ASSEMBLY
1	T-328	CAP, Reservoir	1
2	T-131	TUBE, Reservoir	1
3	T-165	HANDLE, Pump	1
4	T-118	DRIP PAN	1
5	T-199	PLATE, Pump identification	1
6	T-120	BODY, Pump	1
7	T-160	SCREW, Piston pin	1
8	T-161	SHOE, Piston pin	1
9	T-142	PIN, Clevis	2
10	T-144	HAIR PIN, Cotter	2
11	10-90020	BACK-UP RING, Cylinder (T-112)	2
12	10-90013	"O" RING (T-153)	3
13	T-102	HANDLE KNOB, Relief valve	1
14	10-90019	BACK-UP RING, Piston (T-158)	1
15	10-90027	"O" RING	2
16	T-108	PLUG, Cylinder retaining	1
17	T-145	PIN, Piston	1
18	T-236	CYLINDER, Pump	1
19	T-143	CLEVIS	1
20	T-121	HANDLE, Relief valve	1
21	T-149	MANIFOLD ASSEMBLY, (For components see fig. 13)	1
22	T-146	NUT, Union	1
23	T-126	NIPPLE, Union	1
24	10-90009	"O" RING (T-136)	2
25	T-166	SCREW	2
26	T-116	SPRING, Valve rod	1
27	T-133	DETENT PIN, Valve rod	1
28	T-117	PLUG, Pump body	2
29	10-90001	"O" RING (T-152)	3
30	1GT-302	PLUG, Fill & Vent Relief Assembly	1
31	T-127	SPACER, Check valve	2
32	CV-1-5	SPRING, Check valve	3
33	T-147	POPPET, High pressure valve	2
34	T-168	SCREW, Drip pan attaching	4
35	T-167	WASHER, Drip pan attaching	4
36	T-110	STEM, Relief valve	1
37	T-109	BODY, Relief valve	1
38	T-194	POPPET, Valve	1
39	10-90002	"O" RING, Relief valve (T-175)	1

ITEM NUMBER	PART NUMBER	DESCRIPTION	UNITS PER ASSEMBLY
40	10-90004	"O"RING, Valve rod (T-155)	1
41	T-115	VALVE ROD	1
42	10-90005	"O" RING (T-151)	2
43	T-111	SEAT, Relief valve	1
45	10-90010	"O" RING, Reservoir tube (T-156)	2
46	T-130	STUD, Reservoir	1
47	T-140	TUBE, Inlet	1
49	12-90156	FITTING, Inlet tube	1
50	T-170	PLATE, Body	1
51	10-90012	"O" RING, Cylinder (T-164)	1
52	T-106	PISTON	1
53	T-595	LINER, Body plate	1
54	10-90018	BACK-UP RING, piston (T-159)	1
55	T-107	GUIDE ROD	1
56	T-169	SCREW, Body attaching	3
57	T-141	PLUG, Retaining	1
58	T-103	PLUG	1
59	10-90006	"O" RING (T-154)	1
60	10-90014	"O" RING	1
61	01-90058	SCREW	1
62	T-754	CAUTION LABEL	
63	T-755	WARNING LABEL	

MANIFOLD PARTS — FIG. 13 (Pg. 24)

ITEM NUMBER	PART NUMBER	DESCRIPTION	UNITS PER ASSEMBLY
—	T-149	"ASSEMBLY, Type "T" Manifold	—
1	T-163	PLUG, Pipe	1
2	T-135	BODY, Union - ½ NPT	1
3	T-146	NUT, Union	2
4	10-90027	"O" RING (T-154)	3
5	T-126	NIPPLE, Union	2
6	10-90009	"O" RING, Union nipple (T-136	2
7	T-102	KNOB, Handle	2
8	T-119	HANDLE, Vernier	1
9	T-190	PLUG, Friction	1
10	T-174	SCREW, Hub	1
11	T-132	HANDLE HUB, Vernier	1
12	T-186	BODY, Union - 7/16-20 UNF	1
13	10-90005	"O" RING, Nipple (T-151)	2
14	T-185	NIPPLE, 7/16-20 UNF	1
15	T-162	PLUG, Pipe	1
16	T-134	BODY, Union - 1/4 NPT	1
17	T-114	PISTON, Vernier	1
18	T-125	MANIFOLD, Offset pipe	1
19	10-90001	"O" RING, Vernier (T-152)	1
20	10-90017	BACK-UP RING, Vernier (T-179)	1
21	T-113	BUSHING, Vernier piston	1
22	10-90011	"O" RING, Vernier (T-157)	1

DEAD WEIGHT PARTS ---------- FIG. 10 (Pg. 21)

ITEM NUMBER	PART NUMBER	DESCRIPTION	UNITS PER ASSEMBL
1	WG-23	WEIGHT - 0.5 lb. Kirksite	*
1	WG-23Q	WEIGHT - 0.5 lb. Brass	*
2	WG-25	WEIGHT - 2 lbs. Kirksite	*
2	WG-25Q	WEIGHT - 2 lbs. Brass	*
3	WG-56	TUBE CARRIER ASS'Y.	1
4	WG-52	CAP, Cylinder	1
5	WG-78	SCREW, Cylinder clamping	8
6	WG-27	WEIGHT - 10 lbs. Kirksite	*
6	WG-27Q	WEIGHT - 10 lbs. Brass	*
7	WG-89	PISTON AND CYLINDER ASS'Y. - 1/10 Area	*
8	WG-90	PISTON AND CYLINDER ASS'Y. - 1/20 Area	*
9	WG-91	PISTON AND CYLINDER ASS'Y. - 1/50 Area	*
10	WG-92	PISTON AND CYLINDER ASS'Y. - 1/100 Area	*
11	10-90039	BACK-UP RING, Cylinder (WG-108)	*
12	10-90015	"O" RING, Cylinder (WG-111)	*
13	WG-53	TUBE, Weight	1
14	WG-28	BODY, Column	1
15	WG-26	WEIGHT - 9½ lbs. Kirksite	*
15	WG-26Q	WEIGHT - 9½ lbs. Brass	*
16	10-90027	"O" RING (T-154)	2
17	T-206	PLATE, Weight	1
18	WG-83	SCREW, Column body attaching	3
19	01-90016	SCREW, Column base attaching	3
20	T-117	PLUG, Column	1
21	T-244	BASE, Column	1
22	WG-140	COLLAR, Nipple	2
23	WG-139	MALE GLAND, Nipple	2
24	T-246	NIPPLE, Pump connecting	1
25	T-245	BODY, Union	1
26	T-137	INDICATOR, Weight position	1
27	T-178	NUT, Indicator	1
28	T-149	MANIFOLD ASSEMBLY, (For components see pg. 15)	1
29	T-101	HAND PUMP ASSEMBLY, (For components see pg.14)	1
----	T-177	CASE, Carrying	1
----	T-222	CASE, Weight carrying	*

See Chart Pg. 6.

GAUGE AND FITTING ASSEMBLIES ---------- FIG. 12 (Pg. 23)

ITEM NUMBER	PART NUMBER	DESCRIPTION	UNITS PER ASSEMBLY
----		GAUGE AND FITTING ASS'Y.	4
----	T-274	ASS'Y. TEST GAUGE - 4½ in. - 0 to 30 PSI	1**
----	T-275	ASS'Y. TEST GAUGE - 4½ in. - 0 to 160 PSI	1**
----	T-276	ASS'Y. TEST GAUGE - 4½ in. - 0 to 600 PSI	1**
----	T-277	ASS'Y. TEST GAUGE - 4½ in. - 0 to 3,000 PSI	1**
----	T-278	ASS'Y. TEST GAUGE - 4½ in. - 0 to 5,000 PSI	1**
----	T-279	ASS'Y. TEST GAUGE - 4½ in. - 0 to 10,000 PSI	1**
2*	10-90009	"O" RING, Body union (T-136)	4
3*	T-173	BODY, Union	4
4*	10-90027	"O" RING, Body union	4
----	———		

*(Items 2, 3, & 4 - one each per gauge assembly, four each per tester assembly)

SERVICE TOOLS ---------- FIG. 11 (Pg. 23)

ITEM NUMBER	PART NUMBER	DESCRIPTION	UNITS PER ASSEMBLY
1	T-182	WRENCH, Open end, thin 5/8 x 3/4 in.	1
2	1GT-200	WRENCH, Open end, thin 1 in. x 3/4 in.	1
3	T-184	WRENCH, Open end, thin 1-1/8 in.	1
4	1GT-99	PULLER and set assembly, gauge pointer	1
5	T-204	WRENCH, 3/16 in. Hexagon Key, tee handle	1
6	T-239	WRENCH, 1/4 in. Hexagon Key, tee handle	1
7	T-180	WRENCH, 5/32 in. Hexagon Key, short series	1

OPTIONAL ACCESSORY ---------- FIG. 8b (Pg. 18)

ITEM NUMBER	PART NUMBER	DESCRIPTION	UNITS PER ASSEMBLY
----	WG-109	MEMBRANE, Elastomer (see fig. 8b)	1
----	10-90039	BACK-UP RING (WG-108)	1

** See Pg. 6 for list of gauges supplied with each model.

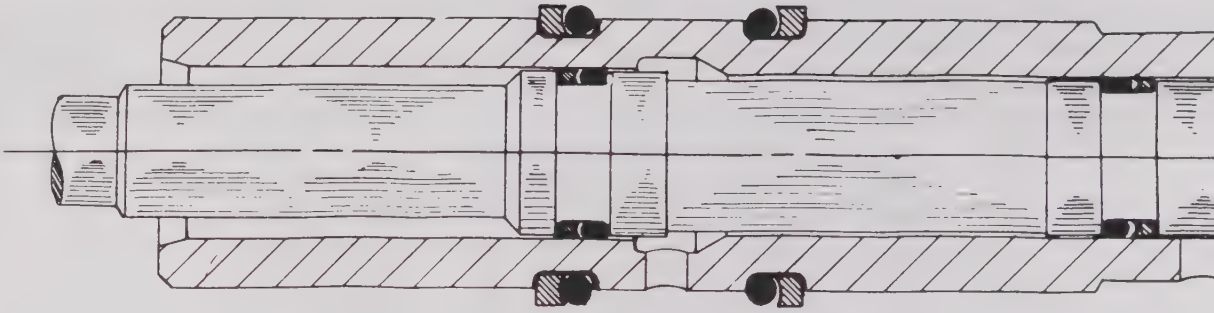


FIG. 7 PUMP PISTON AND CYLINDER ASSEMBLY

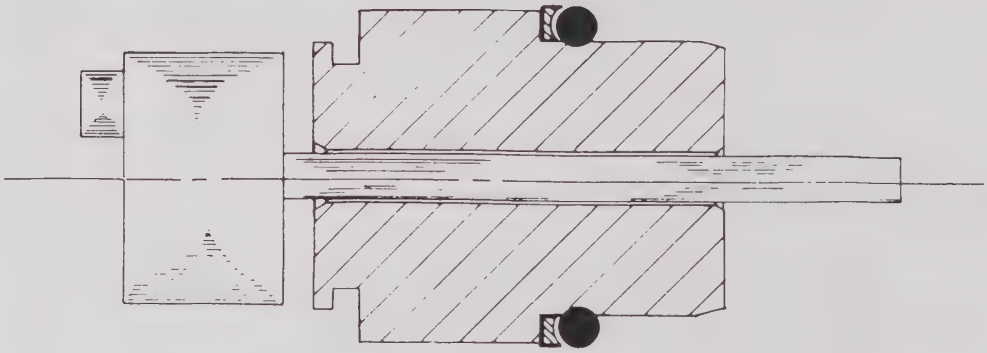


FIG. 8a DEAD WEIGHT PISTON AND CYLINDER ASSEMBLY

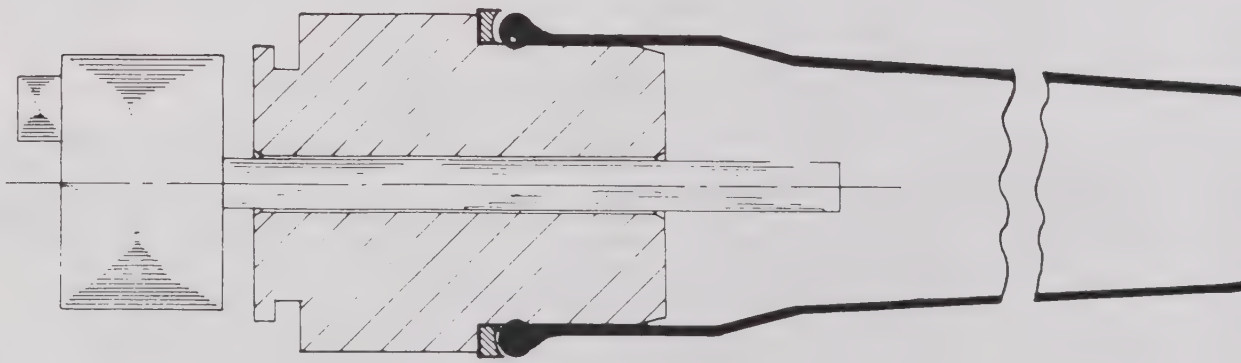
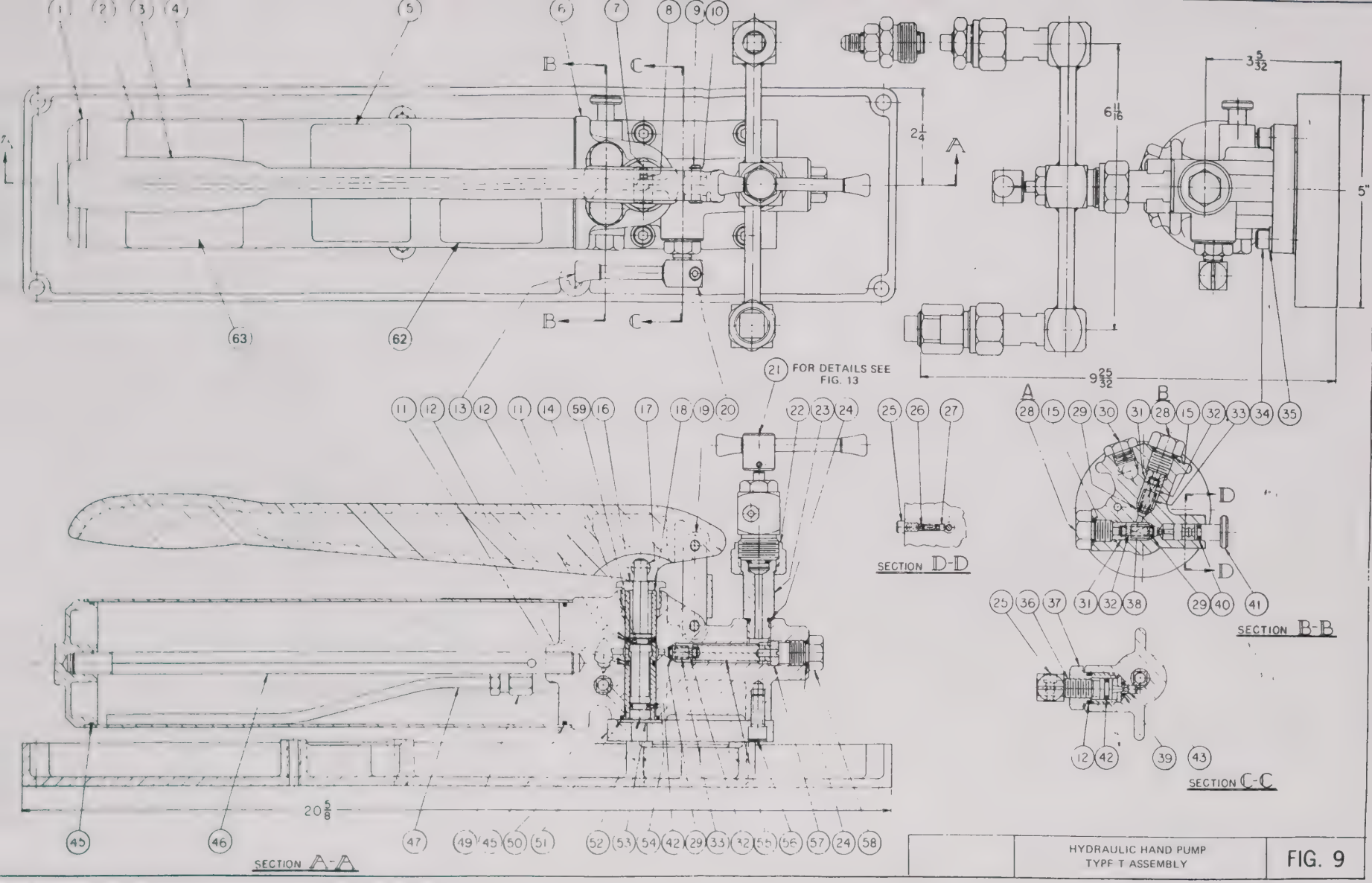
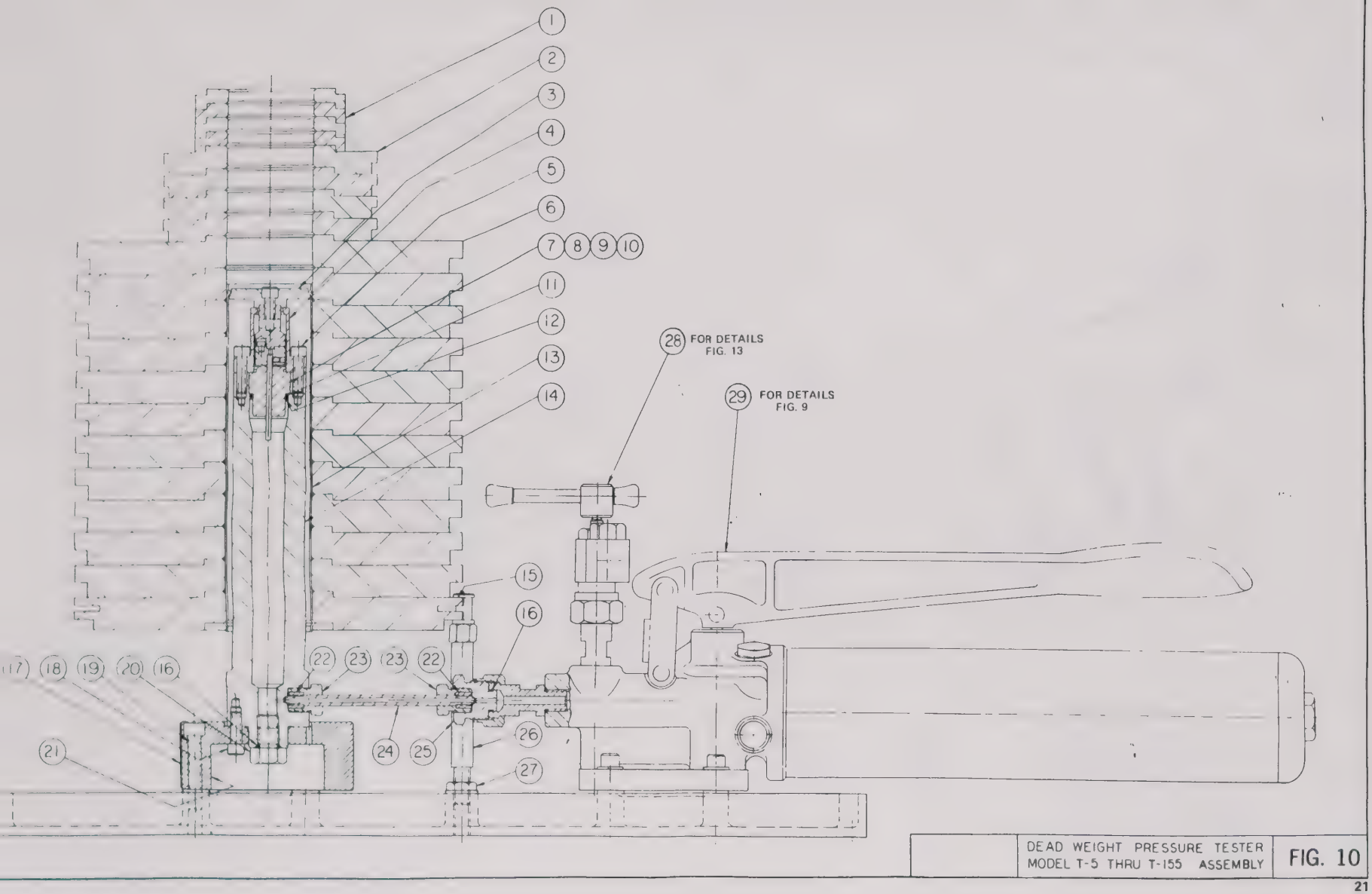


FIG. 8b DEAD WEIGHT PISTON AND CYLINDER ASSEMBLY SHOWING OPTIONAL MEMBE



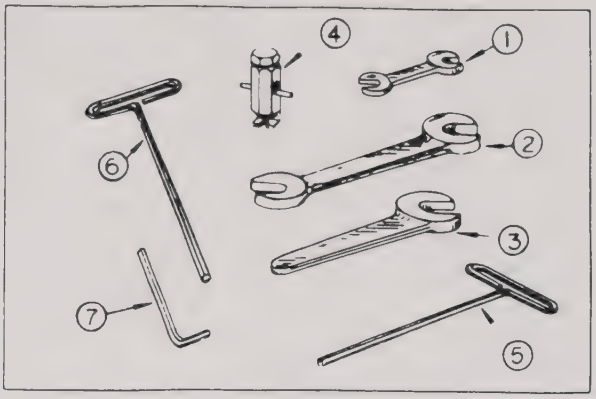
HYDRAULIC HAND PUMP
TYPE T ASSEMBLY

FIG. 9



DEAD WEIGHT PRESSURE TESTER
MODEL T-5 THRU T-155 ASSEMBLY

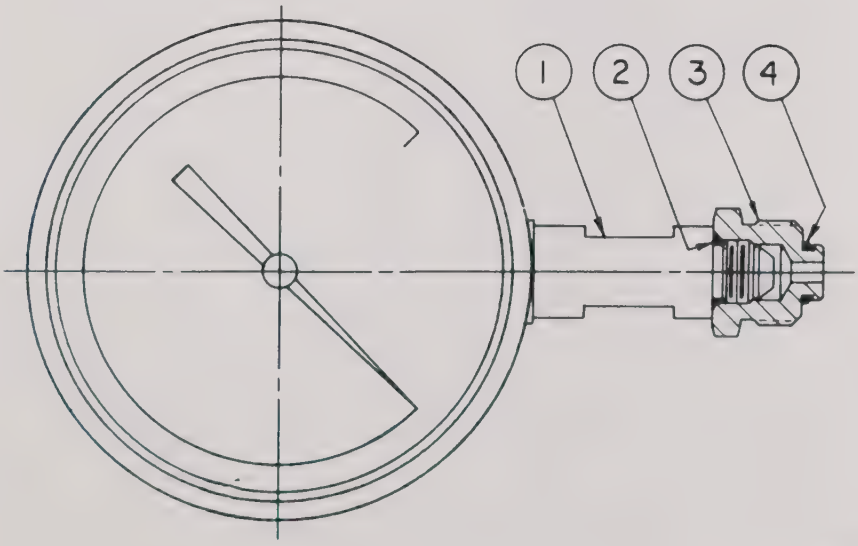
FIG. 10



1 - 5/8 X 3/4 IN WRENCH
2 - 1 IN. X 3/4 IN WRENCH
3 - 1 1/8 IN. WRENCH
4 - GAGE POINTER PULLER AND SET ASSEMBLY
5 - 3/16 IN HEX (TEE HANDLE)
6 - 1/4 IN. HEX (TEE HANDLE)
7 - 5/32 IN HEX KEY

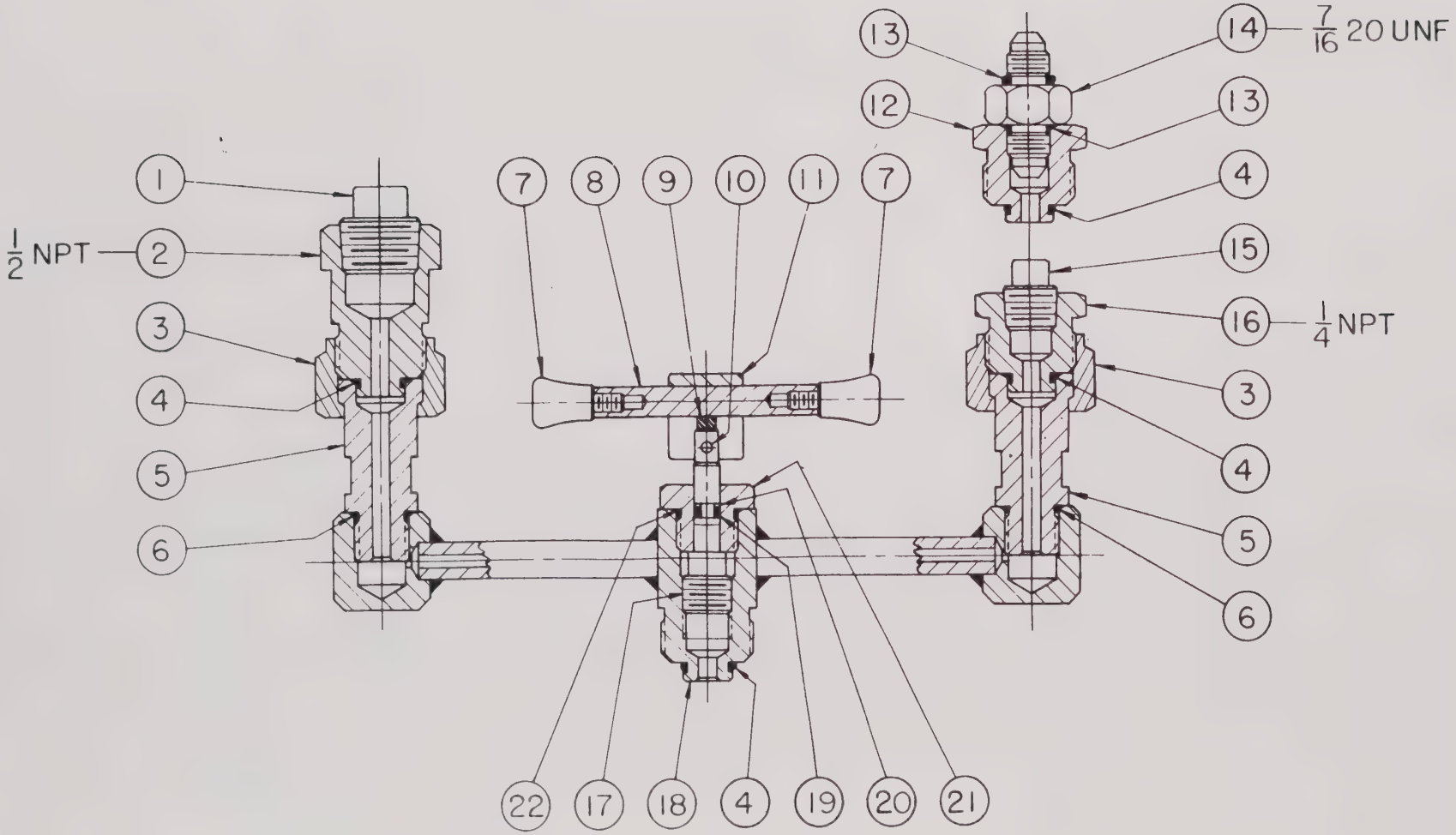
HAND BOOK DRAWING

	SERVICE TOOLS	FIG. 11



HANDBOOK DRAWING

	GAGE AND FITTING ASSEMBLY	FIG. 12



	MANIFOLD ASSEMBLY	FIG. 13

DETAILED INSTRUCTIONS FOR CLEANING PISTON–CYLINDER ASSEMBLIES PRIOR TO PUTTING INTO USE – ALL M & G HYDRAULIC PRESSURE CALIBRATORS

Each Mansfield & Green piston-cylinder assembly is tested during manufacture for pressure retention (leak rate), for sensitivity and for accuracy of calibration, using very close tolerances for each. Each assembly is then cleaned, identified by a serial number and stored until shipped.

It must be remembered that a piston-cylinder assembly for a dead weight gage or calibrator is of necessity a very closely fitted, lapped and mated assembly. Clearances between the piston and cylinder are on the order of 5 to 20 millionths of an inch, and such clearances require utmost cleanliness for satisfactory operation.

Each assembly which is shipped from here separately, not installed in a column assembly, should be cleaned as follows:

1. Carefully wipe off any visible dirt or foreigh matter from the protruding part of the piston and slowly withdraw the piston from the cylinder. Do not use force, but be sure all dirt is removed so that piston will slip out easily.
2. Boil both the piston and cylinder for at least 15 minutes in distilled water. Cylinder bore should be wiped with a small wood handled wiper such as a "Q Tip" to remove all evidence of dirt. Wipe the piston dry and clean with a lint free wiper such as "Kim Wipe".
3. Rinse piston and cylinder in Freon.
4. Wipe cylinder bore and piston again to remove any dirt.
5. Pick up piston by piston cap and dip it in clean fluid to be used in tester, then carefully insert piston in the cylinder. If any feeling of roughness or what might be grit in the annulus area is suspected, disassemble and repeat cleaning procedure.
6. At the same time, the dead weight column in which the piston is to be mounted on types T, R and WG units should be drained and flushed with a solvent such as Freon "TF", then cleaned, dried and refilled using clean fluid.
7. The piston-cylinder assembly then can be inserted carefully in the mounting column and secured as described in paragraph 3.5.

REMEMBER – Do not touch piston with fingers or other soiled or contaminating surfaces after cleaning.

– Extremely minute particles can cause trouble in a closely fitted assembly such as this. It is not possible to over emphasize the value of cleanliness.

RECOMMENDED RECERTIFICATION PROCEDURES

AMETEK, M & G DEADWEIGHT PRESSURE TESTERS

1.0 Introduction

All deadweight pressure testers produced by AMETEK, M & G are tested and certified in M & G laboratory for accuracy of pressure produced, with results traceable to the National Bureau of Standards. In addition, if .03% or .05% accuracy is required, data is furnished showing nominal and observed pressures within the upper 90% of the range of each piston and cylinder, with results directly traceable to the National Bureau of Standards.

This accuracy can degrade with wear resulting from continued use and/or incidental damage. AMETEK, M & G recommends all instruments be periodically retested for accuracy of pressure produced. Testers returned to AMETEK, M & G will be "tested and (re) certified for accuracy traceable to NBS" or "Tested and (re) certified with data furnished traceable to NBS" if tester is in operable condition.

2.0 Frequency of Recertification

The recommended frequency of output pressure recertification is a direct function of the frequency and type of use to which the tester is applied. As a general rule, M & G hydraulic testers (Types T, R, GT, HL) and pneumatic testers (Types PK, 750, HK) should be tested and recertified every 12 months. Testers used frequently, or with dirty fluids, should be tested and certified at more frequent intervals. Master units, used infrequently with clean fluid, will need to be tested and certified less frequently.

3.0 Material Necessary for Recertification

The following parts should be returned to M & G for testing and certification.

3.1 Hydraulic Dead Weight Testers

a. All measuring pistons & cylinders -- Models T, R & WG – WG 89 (.1 sq. in.), WG90 (.05 sq. in.), WG91 (.02 sq. in.), WG92 (.01 sq. in.)

Model 10 – 706 assembly (.02 & 1 sq. in.)

Model HL – T-538 (.05 sq. in.) T-537 (.01 sq. in.)

b. All weights.

c. Weight carrier tubes
Model T & R & WG53
Model HL – T522

d. Tube Carrier Assembly & Cylinder Cap
Model T – WG56 & WG52
Model R – WG56 & T432

Recertification with data traceable to the National Bureau of Standards is available at extra cost.

3.2 Pneumatic Dead Weight Testers

The entire tester and weight set must be returned to M & G for recertification.

4.0 Packaging Instructions

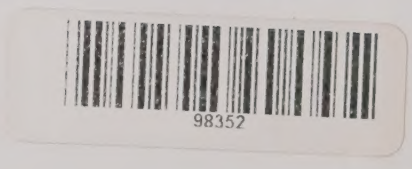
All parts returned to M & G must be securely packaged to preclude damage in shipping.

4.1 Hydraulic Testers

Weights should be packaged individually to preclude damaging each other in transit. Pistons & cylinders should be placed within the plastic shipping vial, protected with oil, and securely packaged to prevent damage.

4.2 Pneumatic Testers

Testers should be returned into their normal cases and the cases packaged to prevent damage in shipping. Weights should be individually packaged in such a manner to preclude shipping damage. Weights should not be placed in the tester case.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